

LITHOCYSTS AS TAXONOMIC MARKERS OF THE SPECIES OF *CORDIA* L. (BORAGINACEAE)

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ABSTRACT

The structure and distribution of lithocysts in the foliar epidermis of eight species of the genus *Cordia* of Boraginaceae are studied. These are mostly distributed on the adaxial surface of the leaf and are restricted to the epidermis only. The qualitative and quantitative characteristics of these cystolith containing cells are found to be useful as taxonomic markers in the identification of the various species of *Cordia*.

KEY WORDS: *Cordia*, Boraginaceae, foliar epidermis, lithocysts

INTRODUCTION

Lithocysts are the cystolith containing cells. These are situated in the epidermis of leaf, usually on the adaxial surface and occasionally on both the surfaces. A perusal of the so far available literature (Solereider 1908; Metcalfe & Chalk 1950, 1979, 1983) clearly reveals that the information available on this aspect in the family Boraginaceae is highly limited. Therefore, in the present investigation, eight species of *Cordia* are studied with emphasis on the structure and distribution of lithocysts.

MATERIALS AND METHODS

Fresh leaf material of *Cordia alba* L.; *C. dichotoma* Forst.; *C. monoica* Roxb.; *C. sebestena* L., and *C. wallichii* G. Don were collected and fixed in Formalin-Aceto-Alcohol, whereas herbarium specimens were secured for *C. domestica* Roth., *C. evolutior* Gamble, and *C. macleodii* Hook. f. & Thomps. For the latter, the material was initially rehydrated by boiling in water. Whole mounts, epidermal peels and transverse sections of the leaf were prepared using traditional methods and microtomy. The frequency, were prepared using traditional methods and microtomy. The frequency, distribution, and size (length and width in surface view and depth in sectional view) were recorded. The presence of calcium carbonate in the cystoliths, was confirmed adopting methods of Jane (1970).

OBSERVATIONS AND DISCUSSION

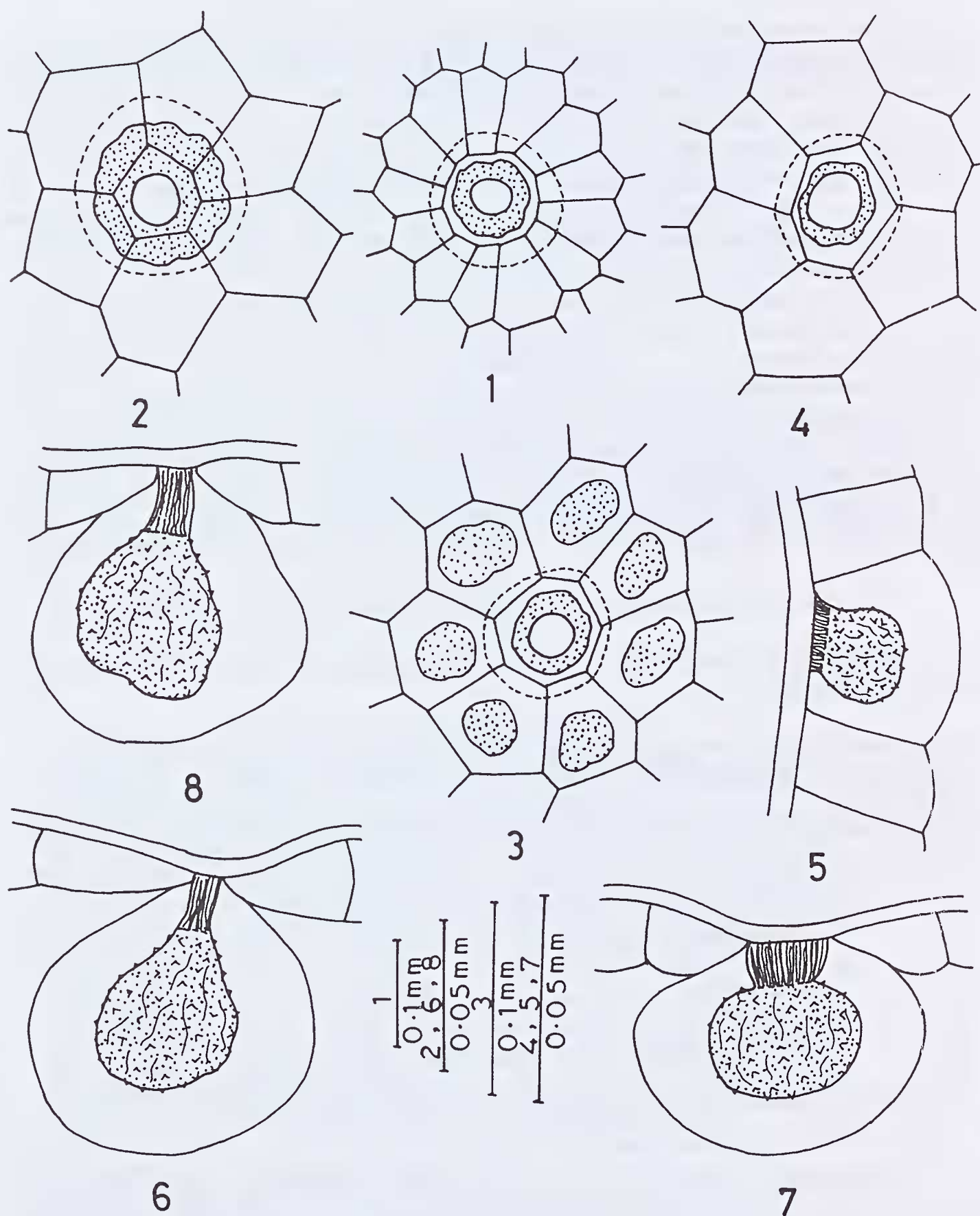
Lithocysts are observed in all these species of *Cordia* (Figures 1-8). The quantitative features of them are presented in Table 1. These are distributed in the costal and intercostal regions of both the epidermal layers in *C. dichotoma* and *C. sebestena*, whereas these are restricted to the adaxial surface only in the remainder of the species. The lithocysts are usually larger than the adjacent epidermal cells and protrude into the mesophyll region in the form of cell cavities (Figures 5-8). In surface view a ring of radiating epidermal cells encircles them, giving the total structures the appearance of trichome bases (Figures 1-4). But the sectional view confirmed the presence of cystoliths inside their cell cavities (Figures 5-8). Sometimes the cystoliths protrude above the general surface giving a papillate appearance as in *C. monoica*, *C. dichotoma*, and *C. macleodii*. A limited number of epidermal cells encircles the lithocysts in *C. evolutior* and *C. sebestena*, (Figures 2,4) whereas numerous small epidermal cells surround them in *C. domestica* (Figure 1). In *C. wallichii*, lithocysts form a characteristic feature of the surface morphology with deeply stained encircling cells giving a rosette appearance to them. The maximum frequency of the lithocysts is recorded in *C. wallichii* (28 per mm²). The largest and smallest lithocysts are observed in *C. monoica* and *C. evolutior* (Figure 7) to ellipsoidal as in *C. wallichii* (Figure 8). Their surface is uniformly verrucose (Figures 5-8).

Table 1. Quantitative characteristics of lithocysts in different species of *Cordia* in the present investigation.

Species Number	Species Name	Frequency (per mm ²)	Length (μm)	Width (μm)	Depth (μm)
1.	<i>Cordia alba</i>	6	95.40	76.32	43.29
2.	<i>C. dichotoma</i>	27	81.40	71.86	58.17
3.	<i>C. domestica</i>	12	78.86	71.23	64.00
4.	<i>C. evolutior</i>	14	70.40	64.05	56.00
5.	<i>C. macleodii</i>	7	208.29	195.57	73.26
6.	<i>C. monoica</i>	20	77.59		66.48
7.	<i>C. sebestena</i>	3	61.05	61.05	52.16
8.	<i>C. wallichii</i>	28	77.59	70.73	69.25

The lithocysts in *Cordia alba* are less specialized with isolated groups of cells in the upper epidermis having thicker outer walls from which knob-like processes impregnated with calcium carbonate project into the cell cavity. In addition to the original lithocyst, adjacent epidermal cells around it may also contain cystolith-like bodies as in *C. macleodii* (Figure 3). Such groups of lithocysts were earlier reported in the family Opiliaceae (see Mauseth 1988).

The lithocysts containing the cystoliths are generally treated as the excretory bodies with reference to their function. Haberlandt (1914) stated that these excretory structures become transformed into repositories of reserve materials and the lime is



Figures 1 -8. Lithocysts of *Cordia*. 1-4. Surface view. 1. *C. domestica*; 2. *C. evolutior*; 3. *C. macleodii*; 4. *C. sebestena*. 5-8. T.S. of adaxial epidermis. 5. *C. alba*; 6. *C. dichotoma*; 7. *C. monoica*; 8. *C. wallichii*.

reintroduced into the metabolic cycle. Bider (1935), on the other hand, considered that the species which possess these lithocysts and related bodies do not flourish unless lime is present in the soil. Therefore, species of *Cordia* may be useful as indicators of lime in the soil.

On the basis of a few available characteristics of lithocysts of the various species of *Cordia* studied here, a tentative key is presented.

1. Lithocysts distributed on both surfaces of the leaf.2
 2. Lithocysts small and less frequent. *C. sebestena*
 2. Lithocysts large and more frequent. *C. dichotoma*
1. Lithocysts distributed only on the adaxial surface of the leaf.3
 3. Lithocysts not protruding into the mesophyll.....*C. alba*
 3. Lithocysts protruding into the mesophyll in the form of deep cavities.4
 4. Lithocysts in groups. *C. macleodii*
 4. Lithocysts solitary.....5
 5. Lithocysts surrounded by numerous small epidermal cells.
.....*C. domestica*
 5. Lithocysts surrounded by limited number of large epidermal cells.6
 6. Cystoliths ellipsoidal.....*C. Wallichii*
 6. Cystoliths spherical.7
 7. Stalk of the cystolith is wide..... *C. monoica*
 7. Stalk of the cystolith is narrow.....*C. evolutior*

Thus the variability expressed in different qualitative and quantitative features by the lithocysts and the cystoliths in the foliar epidermal cells of the species of *Cordia* provide useful taxonomic markers in the infrageneric classification of *Cordia*.

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